directionality and a low peak point at which the ion energy does not contribute to etching to a stage in which a sample is placed independently of the generation of the plasma, and on-off modulating the rf bias voltage to which a peak to peak voltage Vpp value larger than a Vpp value of a continuous rf bias voltage at which the same etch rate can be obtained is given, as illustrated in Fig. 4 of the drawings of this application. More particularly, as pointed out at page 10, line 22 to page 11, line 8 of the specification, "When the frequency lies in a range from about 100 kHz to a few MHz, as shown by the 100 kHz characteristic in Fig. 4, the energy of the ions has a saddle-shaped distribution including a peak 401 of high energy corresponding to the peak to peak amplitude Vpp of the rf bias and a peak 402 of low energy. The peak 402 of low energy corresponds to ions which enter the sheath when the rf bias is 0W...and all of the ions enter a region corresponding to the low energy peak 402 in Fig. 4..." (emphasis added). Furthermore, as pointed out at page 14, line 24 to page 15, line 10 of the specification, "By setting the rf bias to 100 kHz or higher...in order to raise the degree of anisotropy of the etching, it is necessary to set the energy of the ions so as to have a distribution including high and low peak points. Low ion energy does not contribute to etching and high ion energy has a high directionality. ... the ion energy has a distribution including the high and low

peak points." These features are now recited in claim 1 and the dependent claims of this application. Applicants note that claim 2 has been amended to define the feature that the frequency of the rf bias voltage is set to a range from about 100 kHz to a few MHz and the Vpp value of the rf bias voltage is set to 500 V or higher. Also, by the present amendment, claim 3 has been canceled and a new dependent claim 29 has been presented defining the ion energy distribution as being saddle-shaped, as illustrated in Fig. 4.

As to the rejection of claims 1, 4-7 and 24-28 under 35 U.S.C. §102(b) as being anticipated by US 5,352,324 issued to Gotoh et al (hereinafter, Gotoh), and the rejection of claims 1-4 and 24-28 under 35 U.S.C. §102(e) as being anticipated by US 6,093,332 issued to Winniczek et al (hereafter, Winniczek), such rejections are traversed insofar as they are applicable to the present claims, as amended, and reconsideration and withdrawal of the rejections are respectfully requested.

At the outset, as to the requirements to support a rejection under 35 U.S.C. §102, reference is made to the decision of In re Robertson, 49 USPQ 2d 1949 (Fed. Cir. 1999), wherein the court pointed out that anticipation under 35 U.S.C. §102 requires that each and every element as set forth in the claim is found, either expressly or inherently described in a single prior art reference. As noted by the court, if the prior art reference does not expressly set forth

a particular element of the claim, that reference still may anticipate if the element is "inherent" in its disclosure. To establish inherency, the extrinsic evidence "must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill." Moreover, the court pointed out that inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.

Turning first to Gotoh, applicants note that this patent is described at page 11, line 25 to page 12, line 5 of the specification of this application, in conjunction with Fig. 6, which represents a comparative example with respect to the example illustrated in Fig. 5 of the drawings of this application, as obtained by the present invention. That is, Fig. 6 represents a comparative example in accordance with Gotoh, wherein the frequency of the bias power supply was set to 1 kHz and the on-off frequency was set to 1 Hz wherein, as indicated at page 13, lines 2-8 of the specification of this application, even if the rf bias is on-off modulated, when the rf bias frequency is low (Fig. 6) in the comparative, although the verticality of the sidewalls is higher than that of the case using the continuous wave bias, under cutting the curves in the resist 504 and the verticality is lower than of the

case of Fig. 5 to which the method of the present invention is applied. Applicants submit that the differences in the resultant etched structure are apparent from comparison of Fig. 5 (present invention) and Fig. 6 (Gotoh) of the drawings of this application.

Turning to Gotoh, applicants note that col. 5, lines 38-44 in referring to Fig. 2, describes that in such a state that the above plasma was continuously generated (discharged), the ON state and the OFF state of the radio frequency of power applied to the article 7 to etched were repeated [(c) in FIG. 2]. Thus, the absorption of species and the desorption of reaction products were alternately repeated [(d) in FIG. 2]. Furthermore, col. 8, lines 10-14 of Gotoh, describe that "The desired high accurate and high effective etching can be realized by applying the radio frequency power of 1 kHz or more to the article to be etched, while modulating the radio frequency and amplitude with low frequency." (emphasis added). As illustrated, in Fig. 4 of the drawings of this application, when the rf bias frequency is on the order of 1 kHz, the energy distribution becomes very wide as shown by the other curve in Fig. 4 and it is apparent that such curve does not have an ion energy distribution including a high peak point at which the ion energy has high directionality and a low peak point at which the ion energy does not contribute to etching. Thus, applicants submit that Gotoh has been described in the

specification of this application and does not provide any claimed features as recited in claim 1 and the dependent claims of this application in the sense of 35 U.S.C. §102. As noted at page 15, lines 7-10 of the specification of this application, effects of the on-off modulation of the rf bias prove their real worth for the first time when the rf bias is set to 100 kHz or higher, at which level the ion energy has a distribution including the high and low peak points. Thus, applicants submit that claim 1 and the dependent claims patentably distinguish over Gotoh in the sense of 35 U.S.C. §102, and should be considered allowable thereover in that Gotoh does not disclose utilizing an rf bias voltage of a frequency sufficient to provide an ion energy distribution as claimed.

As to the dependent claims, applicants note that the dependent claims recite additional features which when considered with independent claim 1 further distinguish over Gotoh in the sense of 35 U.S.C. §102, and should be considered allowable thereover.

With regard to Winniczek, it is initially noted that the Examiner has not rejected claims 5-7 over this patent, so that at least such claims should be considered allowable thereover.

Irrespective of the Examiner's position concerning the disclosure of Winniczek, applicants note that col. 3, lines 50-59 of this patent, indicates that the pulse RF bias power,

which has a predefined RF frequency, is supplied to the chuck and alternates between a high power level and a low power level at a predefined pulse frequency. By selecting the appropriate pulse frequency, duty cycle, and power levels to allow polymer deposition to occur on the mass surface while the pulse RF bias power is in the low power cycle, overall mask erosion may be reduced. During the high power cycle, etching of the underlying level takes place through openings in the mask. As described at col. 4, lines 37-40 of Winniczek, "The RF energy supply by RF generator 314 may have an RF frequency of, for example, 4 MHz although other RF frequencies may also be employed". Col. 8, lines 34-37, provides that "The high RF bias power level may be between about 600 and about 2500 watts. The low power level may be between about 0 watts to about 1/2 of the high power level, preferably between about 0 watts to about 1/5 of the high power level." Irrespective of this disclosure in Winniczek, applicants note that Winniczek describes a frequency of the RF bias of 4 MHz, but does not disclose that the RF bias voltage is of a frequency which is sufficient to form a ion energy distribution including a high peak point at which the ion energy has directionality and a low peak point at which the ion energy does not contribute to etching, as recited in claim 1 and the dependent claims of this application, nor does Winniczek disclose or teach that the frequency of the RF bias

power supply voltage is set in the range of 100 kHz to a few MHz, as recited in claim 2. Applicants note that the provision of a frequency providing the energy distribution in the manner defined enables the etching to be obtained in the manner described, and applicants submit that such features are not disclosed or taught by Winniczek in the sense of 35 U.S.C. §102, such that claim 1 and its dependent claims patentably distinguish thereover and should be considered allowable thereover.

With regard to the features of the dependent claims, applicants note that at least the Examiner has recognized that the features of claims 5-7 are not disclosed or taught Winniczek, and applicants submit that the other dependent claims recite additional features, which when considered in conjunction with parent claim 1, further patentably distinguish over Winniczek and/or Gotoh in the sense of 35 U.S.C. §102, and should be considered allowable thereover.

In view of the above amendments and remarks, applicants submit that all claims present in this application should now be considered to be in condition for allowance, and issuance of an action of a favorable nature is courteously solicited.

To the extent necessary, applicant's petition for an extension of time under 37 CFR 1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account

No. 01-2135 (520.36911CX2) and please credit any excess fees to such deposit account.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Please amend claims 1 and 2 as follows:

1. (amended) A method of treating a surface of a sample, comprising the steps of:

generating a plasma in a treatment chamber;

applying an rf bias voltage of a frequency sufficient to form an ion energy distribution including a high peak point at which the ion energy has high directionality and a low peak point at which the ion energy does not contribute to etching to a stage on which a sample is placed independently of the generation of the plasma; and

on-off modulating [an] the rf bias voltage to which a peak to peak voltage Vpp value larger than a Vpp value of a continuous rf bias voltage at which the same etch rate can be obtained is given.

2. (amended) A method according to claim 1, wherein the frequency of the rf bias voltage is set to [15 MHz or lower] a range from about 100k Hz to a few MHz and the Vpp value of the rf bias voltage is set to 500V or higher.

Please cancel claim 3 without prejudice or disclaimer of the subject matter thereof, and add the following new claim:

--29. A method according to claim 1, wherein the ion energy distribution is a saddle-shaped ion energy distribution.--